Exercise-1

ONLY ONE OPTION CORRECT TYPE

SECTION : (A) WORK DONE BY CONSTANT FORCE

1. A man pushes wall and fails to displace it. He does
(1) Negative work (2) Positive but not maximum work
(3) No work at all (4) Maximum work

2. A rigid body moves a distance of 10 m along a straight line under the action of a force of 5 N. If the work done by this force on the body is 25 joules, the angle which the force makes with the direction of motion of the body is
(1) 0º (2) 30º (3) 60º (4) 90º

3. A particle moves from position $\vec{r}_1 = 3\hat{i} + 2\hat{j} - 6\hat{k}$ to position $\vec{r}_2 = 14\hat{i} + 13\hat{j} + 9\hat{k}$ under the action of force $4\hat{i} + \hat{j} + 3\hat{k}$ N. The work done by this force will be
(1) 100 J (2) 50 J (3) 200 J (4) 75 J

4. A 50 kg man with 20 kg load on his head climbs up 20 steps of 0.25 m height each. The work done by the man on the block during climbing is
(1) 5 J (2) 350 J (3) 1000 J (4) 3540 J

5. A body which is constrained for move along Y–direction is acted upon by a force $\vec{F} = (-2\hat{i} + 15\hat{j} + 6\hat{k})$N. The work done by this force in displacing the body by 10m along Y–axis is- **(CPMT-94)**
(1) 105 (2) 150 (3) 250 (4) 100

6. Find the workdone in moving a 50 kg. block through a horizontal distance of 10 m by applying a force of 100 N which makes an angle of 60° with the horizontal-
(1) 50 Joule (2) 50 ergs (3) 500 Joule (4) 500 ergs

7. If force $\vec{F} = 5\hat{i} + 3\hat{j} + 4\hat{k}$ makes a displacement of $\vec{s} = 6\hat{i} - 5\hat{k}$, work done by the force is :**(RPMT 2006)**
(1) 10 unit (2) 122 $\sqrt{5}$ unit (3) $5\sqrt{122}$ unit (4) 20 unit

8. A particle of mass 100 g is thrown vertically upwards with a speed of 5 m/s. The work done by the force of gravity during the time the particle goes up is : **(RPMT 2008)**
(1) – 0.5 J (2) – 1.25 J (3) 1.25 J (4) 0.5 J

9. A rope is used to lower vertically a block of mass M at a distance x at a constant downward acceleration g/2. The work done by the rope on the block is- **(CETKuru-2002)**
(1) Mgx (2) $\frac{1}{2}$ Mgx (3) $-\frac{1}{2}$ Mgx (4) Mgx²

10. 300 J of work is done in sliding a 2 kg block up an inclined plane of height 10m. Taking g = 10 m/s$_2$, work done against friction is **(AIPMT 2006)**
(1) 200 J (2) 100 J (3) Zero (4) 1000 J

11. An object is moving along a straight line path from P to Q under the action of a force $\vec{F} = (4\hat{i} - 3\hat{j} + 2\hat{k})$ N. If the co-ordinate of P & Q in metres are (3, 2, −1) & (2, −1, 4) respectively. Then the work done by the force is:
(1) − 15 J (2) 15 J (3) 1015 J (4) 10 J

12. Work done by static friction on an object:
(1) may be positive (2) must be negative
(3) must be zero (4) none of these

13. A rigid body of mass m is moving in a circle of radius r with a constant speed v. The force on the body is $\frac{mv^2}{r}$ and is directed towards the centre. What is the work done by this force in moving the body over half the cirumference of the circle.

(1) $\frac{mv^2}{\pi r^2}$ (2) Zero (3) $\frac{mv^2}{r^2}$ (4) $\frac{\pi r^2}{mv^2}$

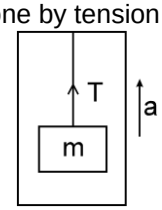
14. A rigid body of mass m kg is lifted uniformly by a man to a height of one metre in 30 sec. Another man lifts the same mass uniformly to the same height in 60 sec. The work done on the body against gravitation by them are in ratio

(1) 1 : 2 (2) 1 : 1 (3) 2 : 1 (4) 4 : 1

15. A ball is released from the top of a tower. The ratio of work done by force of gravity in first, second and third second of the motion of the ball is

(1) 1 : 2 : 3 (2) 1 : 4 : 9 (3) 1 : 3 : 5 (4) 1 : 5 : 3

16. A block of mass m is suspended by a light thread from an elevator. The elevator is accelerating upward with uniform acceleration a. The work done by tension on the block during t seconds is (u = 0) :



(1) $\frac{m}{2}$ (g + a) at_2 (2) $\frac{m}{2}$ (g – a)at_2 (3) $\frac{m}{2}$ gat_2 (4) 0

17. A force $(\vec{F}) = 3\hat{i} + c\hat{j} + 2\hat{k}$ acting on a particle causes a displacement: $(\vec{s}) = -4\hat{i} + 2\hat{j} + 3\hat{k}$ in its own direction. If the work done is 6J, then the value of 'c' is **[CBSE PMT 2002]**

(1) 0 (2) 1 (3) 6 (4) 12

SECTION (B) : WORK DONE BY A VARIABLE FORCE

1. A force acting on a particle varies with the displacement x as F = ax – bx_2. Where a = 1 N/m and b = 1 N/m_2. The work done by this force for the first one meter (F is in newtons, x is in meters) is :

(1) $\frac{1}{6}$J (2) $\frac{2}{6}$J (3) $\frac{3}{6}$J (4) None of these

2. A position dependent force F = 7 – 2x + $3x_2$ newton acts on a small body of mass 2 kg and displaces it from x = 0 to x = 5m. The work done in joules is

(1) 70 (2) 270 (3) 35 (4) 135

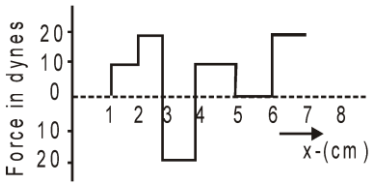
3. A rigid body is acted upon by a horizontal force which is inversely proportional to the distance covered 's'. The work done by this force will be proportional to :

(1) s (2) s_2 (3) $\sqrt{s}$ (4) None of these

4. A force acts on a 3 gm particle in such a way that the position of the particle as a function of time is given by x = 3t – $4t_2$ + t_3, where x is meters and t is in seconds. The work done during the first 4 second is- **(CBSE PMT-98)**

(1) 384 mJ (2) 168 mJ (3) 528 mJ (4) 541 mJ

5. The relationship between force and position is shown in the figure given (in one dimensional case). The work done by the force in displacing a body from x = 1 cm to x = 5 cm is - **(CPMT-1976)**



(1) 20 ergs (2) 60 ergs (3) 70 ergs (4) 700 ergs

6. A body of mass 3 kg is under a constant force which causes a displacement s in metres in it, given by the relation $s = \frac{1}{3}t^2$, where t is in seconds. Work done by the force in 2 seconds is : **(AIPMT 2006)**

(1) $\frac{5}{19}$J (2) $\frac{3}{8}$J (3) $\frac{8}{3}$J (4) $\frac{19}{5}$J

7. The work done by the frictional force on a pencil in drawing a circle of radius r on the surface having a normal pressing force N (coefficient of friction μ_k) is :

(1) $4\pi r^2 \mu_K N$ (2) $-2\pi r^2 \mu_K N$ (3) $-2\pi r \mu_K N$ (4) zero

8. A force F = 5 + 2x acts on a body in x-direction where x is in metres and F in newton. Find the work done in displacing the body from x= 0 to x = 2 m.

(1) 14 J (2) 18 J (3) 16 J (4) none of these

9. A particle of mass 2 kg travels according to equation $S = 3t^3 + 2t$. Find the work done in 3 second of its motion.

(1) 6889 J (2) 6885 J (3) 1782 J (4) none of these

10. A particle moves under the effect of a force F = Cx from x = 0 to $x = x_1$. The work done in the process is

(1) Cx_1^2 (2) $\frac{1}{2}Cx_1^2$ (3) Cx_1 (4) Zero

11. A force $\vec{F} = (5\hat{i} + 3\hat{j} + 2\hat{k})$ N is applied over a particle which displaces it from origin to the point $\vec{r} = (2\hat{i} - \hat{j})$m. The work done on the particle in joules is : **(AIEEE 2004, 4/300)**

(1) – 7 (2) + 7 (3) + 10 (4) + 13

SECTION (C) : WORK ENERGY THEOREM

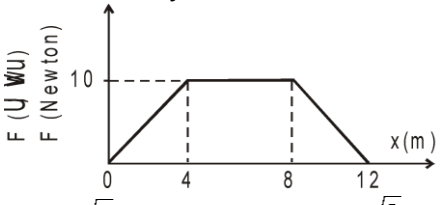
1. The kinetic energy of a body of mass 2 kg and momentum of 2 Ns is

(1) 1 J (2) 2J (3) 3 J (4) 4 J

2. A particle of mass m at rest is acted upon by a force F for a time t. Its kinetic energy after an interval t is :

(1) $\frac{F^2t^2}{m}$ (2) $\frac{F^2t^2}{2m}$ (3) $\frac{F^2t^2}{3m}$ (4) $\frac{Ft}{2m}$

3. A particle of mass 0.1 kg is subjected to a force which varies with distance as shown in figure. If it starts its journey from rest at x = 0, its velocity at x = 12 m is



(1) 0 m/s (2) $20\sqrt{2}$ m/s (3) $20\sqrt{3}$ m/s (4) 40 m/s

4. A heavy stone is thrown from a cliff of height h with a speed v. The stone will hit the ground with maximum speed if it is thrown

(1) vertically downward (2) vertically upward

(3) horizontally (4) the speed does not depend on the initial direction.

5. The work done by all the forces (external and internal) on a system equals the change in
(1) total energy (2) kinetic energy (3) potential energy (4) none of these

6. A body starts from rest with uniform acceleration and acquires a velocity V in time T. The instantaneous kinetic energy of the body after any time t is proportional to :
(1) $(V/T)\,t$ (2) $(V^2/T)t^2$ (3) $(V^2/T^2)\,t$ (4) $(V^2/T^2)t^2$

7. If v, p and E denote the velocity, momentum and kinetic energy of the particle, then :
(1) p = dE/dv (2) p = dE/dt (3) p = dv/dt (4) None of these

8. The total work done on a particle is equal to the change in its kinetic energy
(1) always (2) only if the forces acting on it are conservative
(3) only if gravitational force alone acts on it (4) only if elastic force alone acts on it.

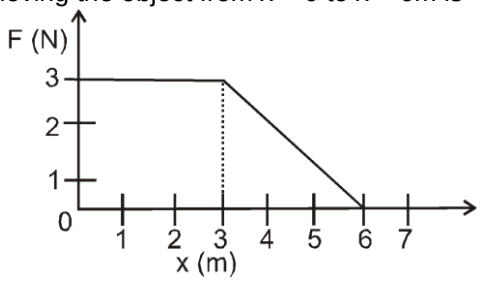
9. When a man walks on a horizontal surface with constant velocity, work done by
(1) friction is zero (2) contact force is non zero
(3) gravity is non zero (4) None of these

10. Given that the displacement of the body in metre is a function of time as follows : $x = 2t^4 + 5$. The mass of the body is 2 kg. What is the increase in its kinetic energy one second after the start of motion-
(1) 8 J (2) 16 J (3) 32 J (4) 64 J

11. If kinetic energy is doubled, find fractional change in momentum : **(RPMT 2006)**
(1) $\sqrt{2}$ (2) $2\sqrt{2}$ (3) $\frac{1}{\sqrt{2}}$ (4) $\frac{1}{2\sqrt{2}}$

12. If kinetic energy of a body is increased by 300% then percentage change in momentum will be **(AIPMT 2002, RPMT 2001)**
(1) 100% (2) 150% (3) 265% (4) 73.2%

13. A force F acting on an object varies with distance x as shown here. The force is in N and x is in m. The work done by the force in moving the object from x = 0 to x = 6m is **(AIPMT 2005)**



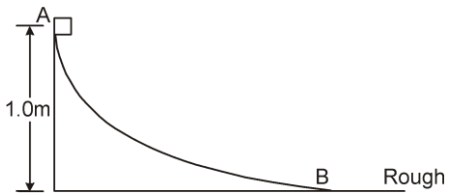
(1) 18.0 J (2) 13.5 J (3) 4.5 J (4) 9.0 J

14. The potential energy of a long spring when stretched by 2cm is U, If the spring is stretched by 8 cm the potential energy stored in it is : **(AIPMT 2006)**
(1) 4 U (2) 8 U (3) 16 U (4) $\frac{U}{4}$

15. You lift a suitcase from the floor and keep it on a table. The work done by you on the suitcase depends on
(1) the path taken by the suitcase (2) the time taken by you in doing so
(3) the weight of the suitcase (4) your weight.

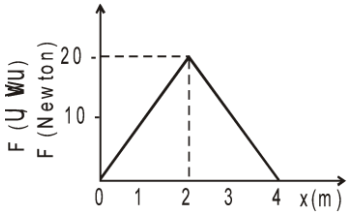
16. The kinetic energy of a particle continuously increases with time
(1) the resultant force on the particle must be parallel to the velocity at all instants.
(2) the resultant force on the particle must be at an angle greater than 90° with the velocity all the time
(3) its height above the ground level must continuously decrease
(4) the magnitude of its linear momentum is increasing continuously

17. A block weighing 10 N travles down a smooth curved track AB joined to a rough horizontal surface (figure). The rough surface has a friction coefficient of 0.20 with the block. If the block starts slipping on the track from a point 1.0 m above the horizontal surface, the distance it will move on the rough surface is :



(1) 5.0 m (2) 10.0 m (3) 15.0 m (4) 20.0 m

18. The graph between the resistive force F acting on a body and the distance covered by the body is shown in the figure. The mass of the body is 25 kg and initial velocity is 2 m/s. When the distance covered by the body is 4m, its kinetic energy would be



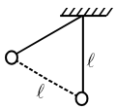
(1) 50 J (2) 40 J (3) 20 J (4) 10 J

19. A retarding force is applied to stop a train. The train stops after 80 m. If the speed is doubled, then the distance travelled when same retarding force is applied is
(1) The same (2) Doubled (3) Halved (4) Four times

20. Which of the following statement is not true?
(1) Work done by conservative force on an object depends only on the initial and final states and not on the path taken.
(2) The change in the potential energy of a system corresponding to conservative internal forces is equal to negative of the work done by these forces.
(3) If some of the internal forces within a system are non-conservative, then the mechanical energy of the system is not constant.
(4) If the internal forces are conservative, the work done by the internal forces is equal to the change in mechanical energy.

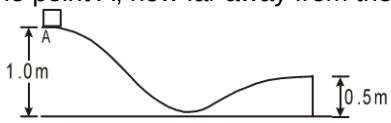
21. When work done by force of gravity is negative (Assume only gravitational force to be acting)
(1) KE increases (2) KE stays constant
(3) PE increases (4) PE stays constant

22. A bob hangs from a rigid support by an inextensible string of length ℓ. If it is displaced through a distance ℓ (from the lowest position) keeping the string straight & then released. The speed of the bob at the lowest position is :



(1) $\sqrt{g\ell}$ (2) $\sqrt{3g\ell}$ (3) $\sqrt{2g\ell}$ (4) $\sqrt{5g\ell}$

23. Figure shows a particle sliding on a frictionless track which terminates in a straight horizontal section. If the particle starts slipping from the point A, how far away from the track will the particle hit the ground ?



(1) At a horizontal distance of 1 m from the end of the track.
(2) At a horizontal distance of 2 m from the end of the track.
(3) At a horizontal distance of 3 m from the end of the track.
(4) Insufficient information

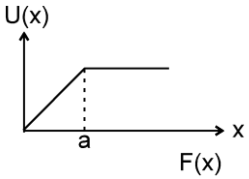
24. Two springs A and B ($k_A = 2k_B$) are strettched by applying forces of equal magnitudes at the four ends. If the energy stored in A is E, that in B is
(1) E/2 (2) 2E (3) E (4) E/4

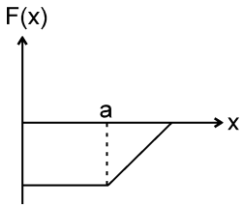
25. A stone projected vertically up with a velocity u reaches a maximum height h. When it is at a height of 3h/4 from the ground, the ratio of KE and PE at that point is : (consider PE = 0 at the point of projectory)
(1) 1 : 1 (2) 1 : 2 (3) 1 : 3 (4) 3 : 1

26. A body is dropped from a certain height. When it loses U amount of its energy it acquires a velocity 'v'. The mass of the body is :
(1) $2U/v_2$ (2) $2v/U_2$ (3) $2v/U$ (4) $U_2/2v$

27. You lift a heavy book from the floor of the room and keep it in the book-shelf having a height 2 m. In this process you take 5 seconds. The work done by you will depend upon **[MP PET 1993]**
(1) Mass of the book and time taken
(2) Weight of the book and height of the book-shelf
(3) Height of the book-shelf and time taken
(4) Mass of the book, height of the book-shelf and time taken

28. The potential energy of a system is represented in the first figure, the force acting on the system will be represented by



(1)


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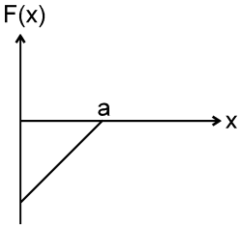

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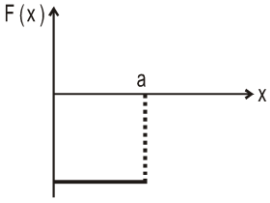

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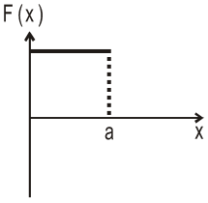
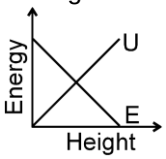
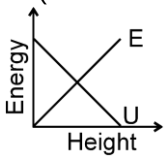


29. Which of the following graphs is correct between kinetic energy (E), potential energy (U) and height (h) from the ground of the particle ($h << R_E$ and U = 0 at h = 0)

(1)


(2)


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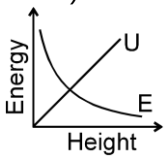

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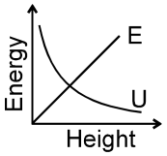
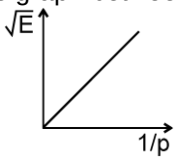


30. The graph between $\sqrt{E}$ and $\frac{1}{p}$ is (E = kinetic energy and p = momentum)

(1)


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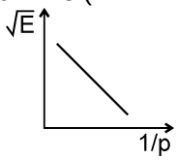

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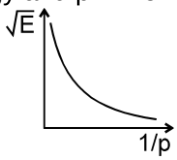

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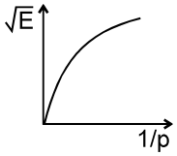


31. If a body loses half of its velocity on penetrating 3 cm in a wooden block, then how much will it penetrate more before coming to rest? **(AIEEE 2002, 4/300)**
(1) 1 cm (2) 2 cm (3) 3 cm (4) 4 cm

32. A particle is projected at 60° to the horizontal with a kinetic energy K. The kinetic energy at the highest point is **(AIEEE 2007, 3/120)**

(1) K (2) zero (3) $K/4$ (4) $K/2$

33. An athlete in the olympic games covers a distance of 100 m in 10 s. His kinetic energy can be estimated to be in the range (Assuming mass of athlete is between 40 kg to 100 kg) **(AIEEE 2008, 3/105)**

(1) $2 \times 10_5$ J – $3 \times 10_5$ J (2) 20,000 J – 50,000 J
(3) 2,000 J – 5,000 J (4) 200 J – 500 J

SECTION (D) : MECHANICAL ENERGY CONSERVATION

1. The negative of the work done by the conservative internal forces on a system equals the change in
(1) total energy (2) kinetic energy (3) potential energy (4) none of these

2. A spring when stretched by 2 mm its potential energy becomes 4 J. If it is stretched by 10 mm, its potential energy is equal to
(1) 4 J (2) 54 J (3) 415 J (4) 100 J

3. A boy is sitting on a swing at a maximum height of 5m above the ground. When the swing passes through the mean position which is 2m above the ground its velocity is approximately- **(RPET-90)**
(1) 7.6 m/sec (2) 9.8 m/sec (3) 6.26 m/sec (4) None of these

4. A force of 10N acts on a body of 2kg mass for a distance of 1m. The kinetic energy received by the body is- **(CPMT-96) (CBSE PMT-96)**
(1) 20 J (2) 10 J (3) 5 J (4) 2.5 J

5. Two springs of spring constants 1500 N/m and 3000 N/m respectively are stretched with the same force. They will have potential energy in the ratio- **(MP PMT-98)**
(1) 4 : 1 (2) 1 : 4 (3) 2 : 1 (4) 1 : 2

6. The kinetic energy K of a particle moving in a straight line depends upon the distance s as $K = as^2$
The force acting on the particle is-

(1) 2as (2) 2mas (3) 2a (4) $\sqrt{as^2}$

7. If a spring extends by x on loading, then the energy stored by the spring is- (T is the tension in the spring and K is force constant)

(1) $\frac{2x}{T^2}$ (2) $\frac{T^2}{2K}$ (3) $\frac{2K}{T^2}$ (4) $\frac{T^2}{2x}$

8. The elastic potential energy of a spring-
(1) Increases only when it is stretched. (2) Decreases only when it is stretched.
(3) Decreases only when it is compressed. (4) Increases whether stretched or compressed.

9. The amount of work done in stretching a spring from a stretched length of 10 cm to a stretched length of 20 cm is-
(1) Equal to the work done in stretching it from 20 cm to 30 cm.
(2) Less than the work done in stretching it from 20 cm to 30 cm.
(3) More than the work done in stretching it from 20 cm to 30 cm.
(4) Equal to the work done in stretching it from 0 to 10 cm.

10. A block of mass 2 kg. collides with a horizontal weightless spring fixed at one end and of force constant 2 N/m. The block compresses the spring by 4 meter from the rest position. The speed of the block at the instant of collision is-
(1) 16 m/sec. (2) 2 m/sec. (3) 4 m/sec. (4) 8 m/sec.

11. An ideal massless spring S can be compressed 2 metre by a force of 200 N. This spring is placed at the bottom of the frictionless inclined plane with makes an angle $\theta = 30°$ with the horizontal. A 20 kg mass is

released from rest at the top of the inclined plane and is brought to rest momentarily after compressing the spring 4 metre. Through what distance does the mass slide before coming to rest- ($g = 10\ m/s^2$)
(1) 2.2 m (2) 4 m (3) 8 m (4) 1.9 m

12. If a 5 kg body falls to the ground from a height of 30 metres and if all its mechanical energy is converted into heat, the heat produced will be- (1 cal = 4.2 joules)
(1) 350 cal (2) 150 cal (3) 60 cal (4) 6 cal

13. The amount of work done in pumping water out of a cubical vessel of height 1 m is nearly- (Take g = 10 m/s^2)
(1) 5,000 J (2) 10,000 J (3) 5 J (4) 10 J

14. A ball is released from certain height which looses 50% of its kinetic energy on striking the ground it will attain a height again : **(RPMT 2000)**
(1) $\frac{1}{4}$ th of initial height (2) $\frac{1}{2}$ th of initial height (3) $\frac{3}{4}$ th of initial height (4) none of these

15. An apple gives 21 kJ energy to a boy. How much height he can climb by using this energy. If his efficiency is 28% ? (mass of boy 40 kg) **(RPMT 2005)**
(1) 22.5 m (2) 15 m (3) 10 m (4) 5 m

16. The potential energy of spring when stretched by a distance x is E. The energy of the spring when stretched by x/2 is - **(RPMT 2011)**
(1) E (2) E/2 (3) E/4 (4) E/6

17. When a spring is stretched by a distance x, it exerts a force, given by **(RPMT 2007)**
$F = (-5x - 16x^3)$ N
The work done, when the spring is stretched from 0.1 m to 0.2 m is :
(1) 8.1×10^{-2} J (2) 12.2×10^{-2} J (3) 8.7×10^{-4} J (4) 12.2×10^{-1} J

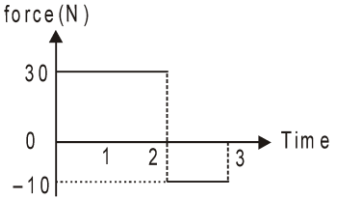
18. A vertical spring with force constant k is fixed on a table. A ball of mass m at a height h above the free upper end of the spring falls vertically on the spring, so that the spring is compressed by a distance d. The net work done in the process is : **(AIPMT/RMPT 2007)**
(1) $mg(h + d) + \frac{1}{2} kd^2$ (2) $mg(h + d) - \frac{1}{2} kd^2$
(3) $mg(h - d) - \frac{1}{2} kd^2$ (4) $mg(h - d) + \frac{1}{2} kd^2$

19. There are two massless springs A and B of spring constant K_A and K_B respectively and $K_A > K_B$. If W_A and W_B be denoted as work done on A and work done on B respectively, then
(1) If they are compressed to same distance, $W_A > W_B$
(2) If they are compressed by same force (upto equilibrium state) $W_A = W_B$
(3) If they are compressed by same distance, $W_A = W_B$
(4) If they are compressed by same force (upto equilibrium state) $W_A > W_B$

20 A block of mass M is hanging over a smooth and light pulley through a light string. The other end of the string is pulled by a constant force F. The kinetic energy of the block increases by 20 J in 1s.
(1) the tension in the string is Mg
(2) the tension in the string is F
(3) the work done by the tension on the block is 20 J in the above 1 s.
(4) the work done by the force of gravity is – 20 J in the above 1s.

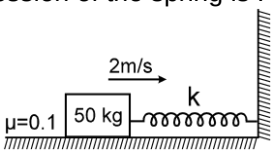
21. A particle of mass m is moving with speed u. It is stopped by a force F in distance x . If the stopping force is 4F then :
(1)work done by stopping force in second case will be same as that in first case.
(2) work done by stopping force in second case will be 2 times of that in first case.
(3) work done by stopping force in second case will be 1/2 of that in first case.
(4) work done by stopping force in second case will be 1/4 of that in first case.

22. Starting at rest, a 10 kg object is acted upon by only one force as indicated in figure. Then the total work done by the force is



(1) 90 J (2) 125 J (3) 245 J (4) 490 J

23. A block of mass 50 kg is projected horizontally on a rough horizontal floor. The coefficient of friction between the block and the floor is 0.1. The block strikes a light spring of stiffness k = 100 N/m with a velocity 2m/s. The maximum compression of the spring is :



(1) 1 m (2) 2 m (3) 3 m (4) 4 m

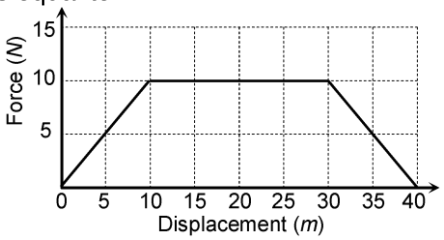
24. A 0.5 kg ball is thrown up with an initial speed 14 m/s and reaches a maximum height of 8.0m. How much energy is dissipated by air drag acting on the ball during the ascent **[AMU (Med.) 2000]**

(1) 19.6 Joule (2) 4.9 Joule (3) 10 Joule (4) 9.8 Joule

25. A particle of mass m_1 is moving with a velocity v_1 and another particle of mass m_2 is moving with a velocity v_2. Both of them have the same momentum but their different kinetic energies are E_1 and E_2 respectively. If $m_1 > m_2$ then **[CBSE PMT 2004]**

(1) $E_1 < E_2$ (2) $\frac{E_1}{E_2} = \frac{m_1}{m_2}$ (3) $E_1 > E_2$ (4) $E_1 = E_2$

26. Adjacent figure shows the force-displacement graph of a moving body, the work done in displacing body from x = 0 $x = 0$ to x = 35 m is equal to **[BHU 1997]**

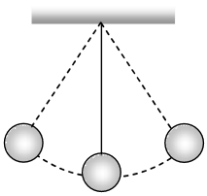


(1) 50 J (2) 25 J (3) 287.5 J (4) 200 J

27. A light and a heavy body have equal kinetic energy. Which one has a greater momentum ? **[NCERT 1974; CPMT 1997; DPMT 2001]**

(1) The light body
(2) The heavy body
(3) Both have equal momentum
(4) It is not possible to say anything without additional information

28. What is the velocity of the bob of a simple pendulum at its mean position, if it is able to rise to vertical height of 10 cm (Take g = 9.8 m/s^2) **[BHU 2000]**



(1) 0.6 m/s (2) 1.4 m/s (3) 1.8 m/s (4) 2.2 m/s

29. A spring of force constant 800 N/m has an extension of 5cm. The work done in extending it from 5cm to 15cm is **(AIEEE 2002, 4/300)**

(1) 16 J (2) 8 J (3) 32 J (4) 24 J

30. A spring of spring constant 5 × 10$_3$ N/m is stretched initially by 5 cm from the unstretched position. Then the work required to stretch it further by another 5 cm is : **(AIEEE 2003, 4/300)**

(1) 12.50 N-m (2) 18.75 N-m (3) 25.00 N-m (4) 6.25 N-m

SECTION (E) : POWER

1. If a motor boat moving with a velocity 3 m/s. If a force 500 N due to flow of water, then power of boat is- **(EAMCET-1982)**
(1) 150 kW (2) 15 kW (3) 1.5 kW (4) 150 W

2. An electric motor creates a tension of 4500 N in a hoisting cable and reels it in at the rate of 2 ms^{-1}. What is the power of the electric motor- **(MNR-1984)**
(1) 15 kW (2) 9 kW (3) 225 kW (4) 9000 HP

3. A weight lifter lifts a weight 300 kg. from ground to a height of 2 m. in 3 sec. Average power developed by him- **(CPMT-1989)**
(1) 2210 watt (2) 8820 watt (3) zero watt (4) 1960 watt

4. An engine is capable of providing 10 kW power, the time taken by it in raising a lift of mass 200 kg to a height of 40m is- ($g = 10 m/sec^2$) **(CPMT-1992)**
(1) 4 sec (2) 5 sec (3) 8 sec (4) 10 sec

5. If a force F is applied on a body and it moves with a velocity v the power will be- **(UP PMT-1997)**
(1) Fv (2) F/v (3) F/v^2 (4) Fv^2

6. A train weighing 10^7 N is running on a level track with uniform speed of 36 km/h. the frictional force is 0.5 kg f per quintal. What is the power of the engine- ($g = 10 m/sec^2$)
(1) 0.5 kw (2) 5 kw (3) 50 kw (4) 500 kw

7. A man is riding on a cycle with velocity 7.2 km/hr up a hill having a slope 1 in 20. The total mass of the man and cycle is 100 kg. The power of the man is-
(1) 98 W (2) 49 W (3) 196 W (4) 147 W

8. A body of mass m kg initially at rest attains a velocity of v m/sec in time t under the action of a constant force F. The power supplied to the mass is-
(1) mv/t (2) mv^2/t (3) Fv (4) Fv/2

9. An engine pumps up 100 kg of water through a height of 10 m in 5 s. Given that, the efficiency of engine is 60%. If g = 10 ms^{-2}, the power of this engine is : **(RPMT 2007)**
(1) 3.3 kW (2) 0.33 kW (3) 0.033 kW (4) 33 kW

10. A kilowatt hour is equal to **(RPMT 2009)**
(1) 3.6×10^6 J (2) 3.6×10^4 J (3) 3.6×10^3 J (4) 3.6×10^{-4} J

11. An engine exerts a force $\vec{F} = (20\hat{i} - 3\hat{j} + 5\hat{k})N$ and moves with velocity $\vec{v} = (6\hat{i} + 20\hat{j} - 3\hat{k})m/s$. The power of the engine (in watt) is : **(AIPMT 2000)**
(1) 45 (2) 75 (3) 20 (4) 10

12. The average power required to lift a 100 kg mass through a height of 50 metres in approximately 50 seconds would be
(1) 50 J/s (2) 5000 J/s (3) 100 J/s (4) 980 J/s

13. An electric motor creates a tension of 4500 N in hoisting cable and reels it at the rate of 2 m/s. What is the power of electric motor ?
(1) 9 W (2) 9 KW (3) 225 W (4) 9000 H.P.

14. A block of mass m is moving with a constant acceleration 'a' on a rough horizontal plane. If the coefficient of friction between the block and plane is μ.The power delivered by the external agent at a time t from the beginning is equal to :
(1) ma^2t (2) μmgat (3) μm(a + μg) gt (4) m(a + μg) at

15. A particle moves with a velocity $\vec{v} = (5\hat{i} - 3\hat{j} + 6\hat{k})$ m/s under the influence of a constant force $\vec{F} = (10\hat{i} + 10\hat{j} + 20\hat{k})$N. The instantaneous power applied to the particle is :
(1) 200 J/s (2) 40 J/s (3) 140 J/s (4) 170 J/s

16. A man M_1 of mass 80 kg runs up a staircase in 15 s. Another man M_2 also of mass 80 kg runs up the stair case in 20 s. The ratio of the power developed by them (P_1 / P_2) will be :
(1) 1 (2) 4/3 (3) 16/9 (4) None of the above

17. A car of mass 'm' is driven with acceleration 'a' along a straight level road against a constant external resistive force 'R'. When the velocity of the car is 'V', the rate at which the engine of the car is doing work will be **[MP PMT/PET 1998; JIPMER 2000]**
(1) RV (2) maV (3) (R + ma)V (4) (ma – R)V

18. An engine pump is used to pump a liquid of density ρ continuously through a pipe of cross-sectional area A. If the speed of flow of the liquid in the pipe is v, then the rate at which kinetic energy is being imparted to the liquid is
(1) $\frac{1}{2}A\rho v^3$ (2) $\frac{1}{2}A\rho v^2$ (3) $\frac{1}{2}A\rho v$ (4) Aρv

19. Power of a water pump is 2 kW. If $g = 10 m/sec^2$, the amount of water it can raise in one minute to a height of 10 m is **[CBSE PMT 1990; Kerala PMT 2004]**
(1) 2000 litre (2) 1000 litre (3) 100 litre (4) 1200 litre

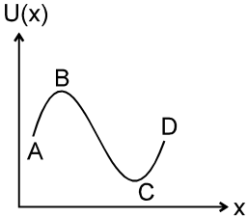
20. A car of mass 1250 kg is moving at 30m/s. Its engine delivers 30 kW while resistive force due to surface is 750N. What max acceleration can be given in the car **[RPET 2000]**
(1) $\frac{1}{3} m/s^2$ (2) $\frac{1}{4} m/s^2$ (3) $\frac{1}{5} m/s^2$ (4) $\frac{1}{6} m/s^2$

21. A body is moved along a straight line by a machine delivering a constant power. The distance moved by the body in time t is proportional to : **(AIEEE 2003, 4/300)**
(1) $t_{3/4}$ (2) $t_{3/2}$ (3) $t_{1/4}$ (4) $t_{1/2}$

22. A body of mass m accelerates uniformly from rest to v_1 in time t_1. The instantaneous power delivered to the body as a function of time t is : **(AIEEE 2004, 4/300)**
(1) $\frac{mv_1 t}{t_1}$ (2) $\frac{mv_1^2 t}{t_1^2}$ (3) $\frac{mv_1 t}{t_1}$ (4) $\frac{mv_1^2 t}{t_1}$

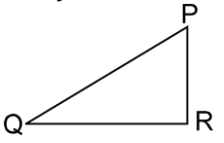
SECTION (F) : CONSERVATIVE & NONCONSERVATIVE FORCES AND EQUILIBRIUM

1. The potential energy of a particle varies with distance x as shown in the graph.



The force acting on the particle is zero at
(1) C (2) B (3) B and C (4) A and D.

2. For the path PQR in a conservative force field (fig.), the amount of work done in carrying a body from P to Q & from Q to R are 5 J & 2 J respectively . The work done in carrying the body from P to R will be -



(1) 7 J (2) 3 J (3) $\sqrt{21}$J (4) zero

3. The potential energy for a force field $\vec{F}$ is given by U(x, y) = sin (x + y). Magnitude of the force acting on the particle of mass m at $\left(0,\frac{\pi}{4}\right)$ is

(1) 1 (2) $\sqrt{2}$ (3) $\frac{1}{\sqrt{2}}$ (4) 0

4. A particle is moving in a potential region given by U = K ($x^2 + y^2 + z^2$). The force acting on the particle is given by-

(1) $-2k(x\hat{i}+y\hat{j}+z\hat{k})$ (2) $k(x\hat{i}+y\hat{j}+z\hat{k})$ (3) $\frac{k}{2}(x\hat{i}+y\hat{j}+z\hat{k})$ (4) $k(x^2\hat{i}+y^2\hat{j}+z^2\hat{k})$

5. The potential energy of a body is given by $U = A - Bx_2$ (where x is the displacement). The magnitude of force acting on the particle is **(RPMT 2009)**

(1) constant (2) proportional to x (3) proportional to x_2 (4) proportional to 1/x

6. The work done by the external forces on a system (internal forces are conservative) equals the change in

(1) total energy (2) kinetic energy (3) potential energy (4) none of these

7. The potential energy of a particle varies with x according to the relation $U(x) = x_2 - 4x$. The point x = 2 is a point of :

(1) stable equilibrium (2) unstable equilibrium
(3) neutral equilibrium (4) none of above

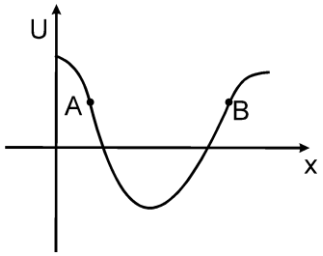
8. The potential energy function associated with the force $\vec{F} = 4xy\,\hat{i} + 2x^2\hat{j}$ is :

(1) $U = -2x_2 y$ (2) $U = -2x_2 y$ + constant
(3) $U = 2x_2 y$ + constant (4) not defined

9. One of the forces acting on a particle is conservative then which of the following statement(s) are true about this conservative force

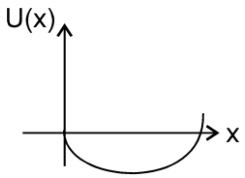
(1) Its work is non zero when the particle moves exactly once around any closed path.
(2) Its work equals the change in the kinetic energy of the particle
(3) Then that particular force must be constant.
(4) Its work depends on the end points of the motion, not on the path between.

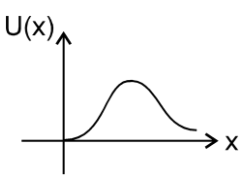
10. Potential energy v/s displacement curve for one dimensional conservative field is shown. Force at A and B is respectively.

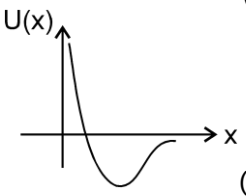


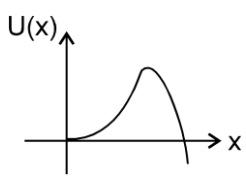
(1) Positive, Positive (2) Positive, Negative (3) Negative, Positive (4) Negative, Negative

11. A particle, which is constrained to move along the x-axis, is subjected to a force in the same direction which varies with the distance x of the particle from the origin as $F(x) = -kx + ax_3$. Here k and a are positive constants. For $x \geq 0$, the functional form of the potential energy U(x) of the particle is **(JEE(Scr) 2002, 3/105)**

(1) 

(2) 

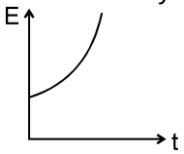
(3) 

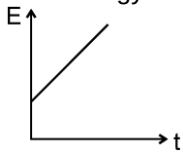
(4) 

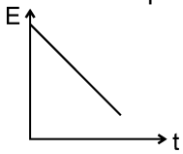
Exercise-2

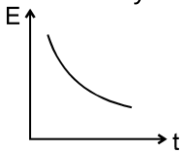
1. The work done in slowly pulling up a block of wood weighing 2 kN for a length of 10m on a smooth plane inclined at an angle of 15º with the horizontal by a force parallel to the incline is
(1) 4.36 kJ (2) 5.17 kJ (3) 8.91 kJ (4) 9.82 kJ

2. Two equal masses are attached to the two ends of a spring of spring constant k. The masses are pulled out symmetrically to stretch the spring by a length x over its natural length. The work done by the spring on each mass during the above pulling is
(1) $\frac{1}{2}kx^2$ (2) $-\frac{1}{2}kx^2$ (3) $\frac{1}{4}kx^2$ (4) $-\frac{1}{4}kx^2$

3. A particle is dropped from a height h. A constant horizontal velocity is given to the particle. Taking g to be constant every where, kinetic energy E of the particle with respect to time t is correctly shown in
(1) 

(2) 

(3) 

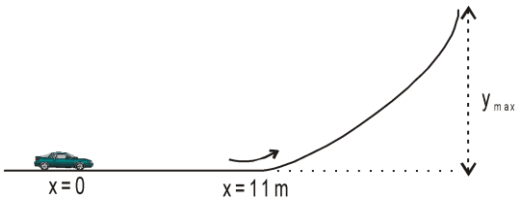
(4) 

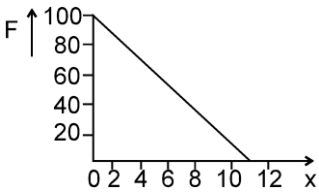
4. A body moving at 2 m/s can be stopped over a distance x. If its kinetic energy is doubled, how long will it go before coming to rest, if the retarding force remains unchanged ?
(1) x (2) 2x (3) 4x (4) 8x

5. A rod of length 1m and mass 0.5 kg hinged at one end, is initially hanging vertical. The other end is now raised slowly until it makes an angle 60º with the vertical. The required work is :(use g = 10 m/s^2)
(1) $\frac{5}{2}$J (2) $\frac{5}{4}$J (3) $\frac{17}{8}$J (4) $\frac{5\sqrt{3}}{4}$J

6. A particle moves in a straight line with retardation proportional to its displacement. Its loss of kinetic energy for any displacement x is proportional to
(1) x^2 (2) e^x (3) x (4) $\log_e x$

7. A small mass slides down an inclined plane of inclination θ with the horizontal. The co-efficient of friction is $\mu = \mu_0 x$ where x is the distance through which the mass slides down and μ_0 is a constant. Then the distance covered by the mass before it stops is:
(1) $\frac{2}{\mu_0}\tan\theta$ (2) $\frac{4}{\mu_0}\tan\theta$ (3) $\frac{1}{2\mu_0}\tan\theta$ (4) $\frac{1}{\mu_0}\tan\theta$

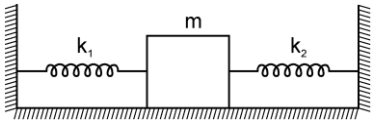
8. A toy car of mass 5 kg starts from rest and moves up a ramp under the influence of force F (F is applied in the direction of velocity) plotted against displacement x. The maximum height attained is given by




(1) y_{max} = 20 m (2) y_{max} = 15 m (3) y_{max} = 11 m (4) y_{max} = 5 m

9. _____ of a two particle system depends only on the separation between the two particles. The most appropriate choice for the blank space in the above sentence is
(1) kinetic energy (2) total mechanical energy
(3) potential energy (4) total energy

10. A block of mass m is attached to two unstretched springs of spring constants k_1 and k_2 as shown in figure. The block is displaced towards right through a distance x and is released. Find the speed of the block as it passes through the mean position shown.

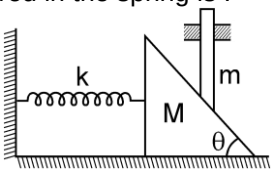


(1) $\sqrt{\frac{k_1+k_2}{m}}\,x$ (2) $\sqrt{\frac{k_1k_2}{m(k_1+k_2)}}x$ (3) $\sqrt{\frac{k_1^2k_2^2}{m(k_1^2+k_2^2)}}x$ (4) $\sqrt{\frac{k_1^3k_2^3}{m(k_1^3+k_2^3)}}$

11. A spring of spring constant k placed horizontally on a rough horizontal surface is compressed against a block of mass m placed on the surface so as to store maximum energy in the spring. If the coefficient of friction between the block and the surface is μ, the potential energy stored the spring is :

(1) $\frac{\mu^2m^2g^2}{k}$ (2) $\frac{2\mu m^2g^2}{k}$ (3) $\frac{\mu^2m^2g^2}{2k}$ (4) $\frac{3\mu^2mg^2}{k}$

12. A wedge of mass M fitted with a spring of stiffness 'k' is kept on a smooth horizontal surface. A rod of mass m is kept on the wedge as shown in the figure. System is in equilibrium. Assuming that all surfaces are smooth, the potential energy stored in the spring is :



(1) $\frac{mg^2\tan^2\theta}{2K}$ (2) $\frac{m^2g\tan^2\theta}{2K}$ (3) $\frac{m^2g^2\tan^2\theta}{2K}$ (4) $\frac{m^2g^2\tan^2\theta}{K}$

13. The spring extends by x on loading, then energy stored by the spring is (if T is the tension in spring and k is spring constant).

(1) $\frac{T^2}{2k}$ (2) $\frac{T^2}{2k^2}$ (3) $\frac{2k}{T^2}$ (4) $\frac{2T^2}{k}$

14. A body of mass m dropped from a certain height strikes a light vertical fixed spring of stiffness k. The height of its fall before touching the spring if the maximum compression of the spring is equal to $\frac{3mg}{k}$ is :

(1) $\frac{3mg}{2k}$ (2) $\frac{2mg}{k}$ (3) $\frac{3mg}{4K}$ (4) $\frac{mg}{4K}$

15. A running man has half the kinetic energy of that of a boy of half of his mass. The man speeds up by 1 m/s so as to have same kinetic energy as that of the boy. The original speed of the man will be

(1) $\sqrt{2}\,m/s$ (2) $(\sqrt{2}-1)m/s$ (3) $\frac{1}{(\sqrt{2}-1)}m/s$ (4) $\frac{1}{\sqrt{2}}m/s$

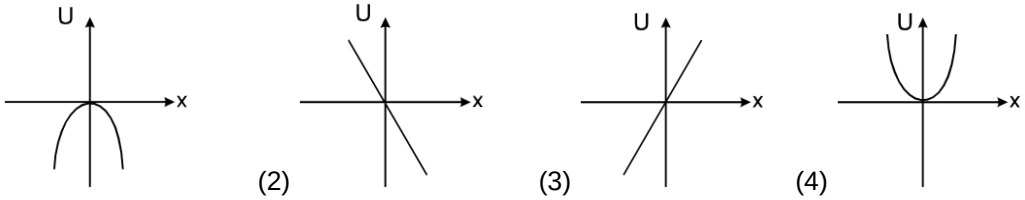
16. A car of mass 'm' is driven with acceleration 'a' along a straight level road against a constant external resistive force 'R'. When the velocity of the car is 'V', the rate at which the engine of the car is doing work will be

(1) RV (2) maV (3) (R + ma)V (4) (ma – R)V

17. An ideal spring with spring-constant k is hung from the ceiling and a block of mass M is attached to its lower end. The mass is released with the spring initially unstreched. Then the maximum extension in the spring is **(JEE(Scr) 2002, 3/105)**

(1) 4 Mg/k (2) 2 Mg/k (3) Mg/k (4) Mg/2k

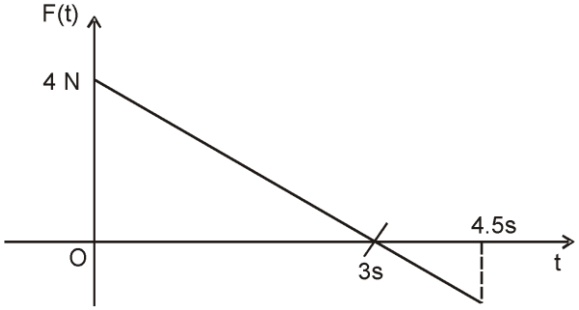
18. A particle moves under the influence of a force F = kx in one dimensions (k is a positive constant and x is the distance of the particle from the origin). Assume that the potential energy of the particle at the origin is zero, the schematic diagram of the potential energy U as a function of x is given by **(JEE(Scr) 2004, 3/84)**



(1) (2) (3) (4)

19. **STATEMENT - 1 :** A block of mass m starts moving on a rough horizontal surface with a velocity v. It stops due to friction between the block and the surface after moving through a certain distance. The surface is now tilted to an angle of 30º with the horizontal and the same block is made to go up on the surface with the same initial velocity v. The decrease in the mechanical energy in the second situation is smaller than that in the first situation.
Because
STATEMENT – 2 The coefficient of friction between the block and the surface decreases with the increase in the angle of inclination. **(JEE 2007' 3/184)**
(1) Statement-1 is True, Statement-2 is True; Statement-2 **is** a correct explanation for Statement-1
(2) Statement-1 is True, Statement-2 is True; Statement-2 **is NOT** a correct explanation for Statement-1
(3) Statement-1 is True, Statement-2 is False
(4) Statement-1 is False, Statement-2 is True.

20. A block of mass 2 kg is free to move along the x-axis. It is at rest and from t = 0 onwards it is subjected to a time-dependent force F (t) in the x direction. The force F (t) varies with t as shown in the figure. The kinetic energy of the block after 4.5 seconds is : **(JEE 2010, 5/160, – 2)**

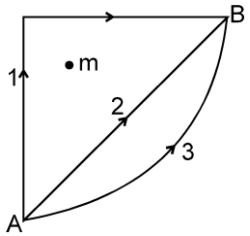


(1) 4.50 J (2) 7.50 J (3) 5.06 J (4) 14.06 J

21. A body of mass 10kg at rest is acted upon simultaneously by two forces 4 N and 3N at right angles to each other. The kinetic energy of the body at the end of 10 sec is **[Kerala (Engg.) 2001]**
(1) 100 J (2) 300 J (3) 50 J (4) 125 J

22. When work is done on a body by an external force, its
(1) Only kinetic energy increases
(2) Only potential energy increases
(3) Both kinetic and potential energies may increase
(4) Sum of kinetic and potential energies remains constant

23. If W_1, W_2 and W_3 represent the work done in moving a particle from A to B along three different paths 1, 2, 3 respectively (as shown) in the gravitational field of a point mass m, find the correct relation between W_1, W_2 and W_3



(1) $W_1 > W_2 > W_3$ (2) $W_1 = W_2 = W_3$ (3) $W_1 < W_2 < W_3$ (4) $W_2 > W_1 > W_3$

24. An open knife edge of mass 'm' is dropped from a height 'h' on a wooden floor. If the blade penetrates upto depth 'd' into the wood, the average resistance offered by the wood to the knife edge is

(1) mg (2) $mg\left(1-\frac{h}{d}\right)$ (3) $mg\left(1+\frac{h}{d}\right)$ (4) $mg\left(1+\frac{h}{d}\right)^2$

Exercise-3

PART - I : NEET / AIPMT QUESTION (PREVIOUS YEARS)

1. A body of mass 1 kg is thrown upwards with a velocity 20 ms^{-1}. It momentarily comes to rest after attaining a height of 18 m. How much energy is lost due to air friction? (g = 10 ms^{-2}) **[AIPMT 2009]**
(1) 20 J (2) 30 J (3) 40 J (4) 10 J

2. An engine pumps water continuously through a hose. Water leaves the hose with a velocity υ and m is the mass per unit length of the water jet. What is the rate at which kinetic energy is imparted to water? **[AIPMT 2009]**
(1) $\frac{1}{2}mv^3$ (2) mv^3 (3) $\frac{1}{2}mv^2$ (4) $\frac{1}{2}m^2v^2$

3. A block of mass M is attached to the lower end of a vertical spring. The spring is hung from a ceiling and has force constant value k. The mass is released from rest with the spring initially unstretched. The maximum extension produced in the length of the spring will be **[AIPMT 2009]**
(1) Mg/k (2) 2 Mg/k (3) 4 Mg/k (4) Mg/2k

4. An engine pumps water through a hose pipe. Water passes through the pipe and leaves it with a velocity of 2 m/s. The mass per unit length of water in the pipe is 100 kg/m. What is the power of the engine? **[AIPMT 2010 (Screening)]**
(1) 400 W (2) 200 W (3) 100 W (4) 800 W

5. A particle of mass M, starting from rest, undergoes uniform acceleration. If the speed acquired in time T is V, the power delivered to the particle is **[AIPMT 2010 (Mains)]**
(1) $\frac{MV^2}{T}$ (2) $\frac{1}{2}\frac{MV^2}{T^2}$ (3) $\frac{MV^2}{T^2}$ (4) $\frac{1}{2}\frac{MV^2}{T}$

6. The potential energy of a system increases if work is done : **[AIPMT 2011 (Screening)]**
(1) upon the system by a nonconservative force
(2) by the system against a conservative force
(3) by the system against a nonconservative force
(4) upon the system by a conservative force

7. The potential energy of particle in a force field is $U = \frac{A}{r^2} - \frac{B}{r}$, where A and B are positive constants and r si the distance of particle from the centre of the field. For stable equilibrium, the distance of the particle is : **[AIPMT (Pre) 2012]**
(1) B / 2A (2) 2A / B (3) A / B (4)B / A

8. A car of mass m starts from rest and accelerates so that the instantaneous power delivered to the car has a constant magnitude P_0. The instantaneous velocity of this car is proportional to : **[AIPMT 2012 (Mains)]**
(1) t^2P_0 (2) $t_{1/2}$ (3) $t_{-1/2}$ (4) $\frac{t}{\sqrt{m}}$

9. A block of mass 10 kg, moving in x direction with a constant speed of 10ms^{-1}, is subject to a retarding force F = 0.1 x J/m during its travel from x = 20 m to 30 m. Its final KE will be: **[AIPMT-2015]**
(1) 450 J (2) 275 J (3) 250 J (4) 475 J

10. Two similar springs P and Q have spring constants K_P and K_Q, such that $K_P > K_Q$. They are stretched, first by the same amount (case a), then by the same force (case b). The work done by the springs W_P and W_Q are related as, in case (a) and case (b), respectively : **[AIPMT-2015]**

(1) $W_P = W_Q$; $W_P = W_Q$ (2) $W_P > W_Q$; $W_Q > W_P$

(3) $W_P < W_Q$; $W_Q < W_P$ (4) $W_P = W_Q$; $W_P > W_Q$

11. A particle of mass m is driven by a machine that delivers a constant power k watts. If the particle starts from rest the force on the particle at time is : **[AIPMT-2015]**

(1) $\sqrt{mk}t^{-1/2}$ (2) $\sqrt{2mk}t^{-1/2}$ (3) $\frac{1}{2}\sqrt{mk}t^{-1/2}$ (4) $\sqrt{\frac{mk}{2}}t^{-1/2}$

12. A particle moves from a point $(-2\hat{i}+5\hat{j})$ to $(4\hat{j}+3\hat{k})$ when a force of $(4\hat{i}+3\hat{j})N$ is applied. How much work has been done by the force? **[NEET 2016]**

(1) 2J (2) 8 J (3) 11 J (4) 5 J

13. Consider a drop of rain water having mass 1 g falling from a height of 1 km. It hits the ground with a speed of 50 m/s. Take 'g' constant with a value 10 m/s^2. The work done by the (i) gravitational force and the (ii) resistive force of air is : **[NEET 2017]**

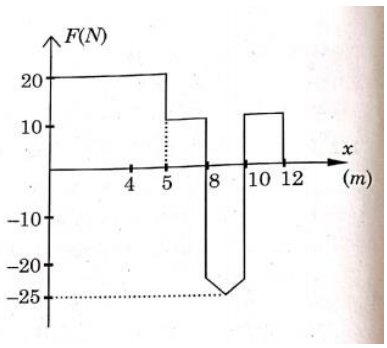
(1) (i) – 10 J (ii) – 8.25 J (2) (i) 1.25 J (ii) – 8.25 J

(3) (i) 100 J (ii) 8.75 J (4) (i) 10 J (ii) – 8.75 J

14. A force F = 20 + 10y acts on a particle in y-direction where F is in Newton and y in meter. Work done by this force to move the particle from y = 0 to y = 1 m is: **[NEET-1_2019]**

(1) 20 J (2) 30 J (2) 5 J (4) 25 J

15. An object of mass 500 g, initially at rest, is acted upon by a variable force whose X-component varies with X in the manner shown. The velocities of the object at the points X = 8 m and X = 12 m, would have the respective values of (nearly) **[NEET-2_2019]**



(1) 18 m/s and 24.4 m/s (2) 23 m/s and 24.4 m/s

(3) 23 m/s and 20.6 m/s (4) 18 m/s and 20.6 m/s

PART - II : JEE (MAIN) / AIEEE PROBLEMS (PREVIOUS YEARS)

1. At time t = 0s a particle starts moving along the x-axis. If its kinetic energy increases uniformly with time 't', the net force acting on it must be proportional to : **[AIEEE 2011, 11 May; 4, –1]**

(1) constant (2) t (3) $\frac{1}{\sqrt{t}}$ (4) $\sqrt{t}$

2. When a rubber-band is stretched by a distance x, it exerts a restoring force of magnitude F = ax + bx^2 where a and b are constants. The work done in stretching the unstretched rubber-band by L is : **[JEE- Main - 2014]**

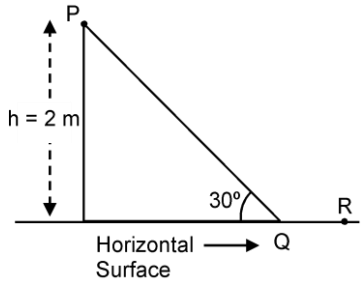
(1) $aL_2 + bL_3$ (2) $\frac{1}{2}(aL_2 + bL_3)$ (3) $\frac{aL^2}{2}+\frac{bL^3}{3}$ (4) $\frac{1}{2}\left(\frac{aL^2}{2}+\frac{bL^3}{3}\right)$

3. A person trying to lose weight by burning fat lifts a mass of 10 kg upto a height of 1 m 1000 times. Assume that the potential energy lost each time he lowers the mass is dissipated. How much fat will he use up considering the work done only when the weight is lifted up ? Fat supplies 3.8×10^7 J of energy per kg which is converted to mechanical energy with a 20% efficiency rate. Take g = 9.8 ms^{-2}

[JEE Main 2016]

(1) 6.45×10^{-3} kg (2) 9.89×10^{-3} kg (3) 12.89×10^{-3} kg (4) 2.45×10^{-3} kg

4. A point particle of mass m, moves along the uniformly rough track PQR as shown in the figure. The coefficient of friction, between the particle and the rough track equals μ. The particle is released, from rest, from the point P and it comes to rest at a point R. The energies, lost by the ball, over the parts, PQ and QR, of the track, are equal to each other, and no energy is lost when particle changes direction from PQ to QR. The values of the coefficient of friction μ and the distance x (= QR), are, respectively close to : **[JEE Main 2016]**



(1) 0.2 and 3.5 m (2) 0.29 and 3.5 m (3) 0.29 and 6.5 m (4) 0.2 and 6.5 m

5. A time dependent force F = 6t acts on a particle of mass 1kg. If the particle starts from rest, the work done by the force during the first 1 sec. will be : **[JEE Main 2017]**

(1) 18 J (2) 4.5 J (3) 22 J (4) 9 J

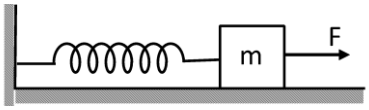
6. A body of mass m = 10^{-2} kg is moving in a medium and experiences a frictional force F = $-kv^2$. Its initial speed is v_0 = 10 ms^{-1}. If after 10 s, its energy is $\frac{1}{8}mv_0^2$, the value of k will be :**[JEE Main 2017] [WPE]**

(1) 10^{-1}Kg $m^{-1}s^{-1}$ (2) 10^{-3}Kg m^{-1} (3) 10^{-3}Kg s^{-1} (4) 10^{-4}Kg m^{-1}

7. A particle is moving in a circular path of radius a under the action of an attractive potential U = $-\frac{k}{2r^2}$. Its total energy is : **[JEE-Main-2018]**

(1) zero (2) $-\frac{3}{2}\frac{k}{a^2}$ (3) $-\frac{k}{4a^2}$ (4) $\frac{k}{2a^2}$

8. A block of mass m, lying on a smooth horizontal surface, is attached to a spring (of negligible mass) of spring constant k. The other end of the spring is fixed, as shown in figure. The block is initially at rest in its equilibrium position. If now the block is pulled with a constant force F, the maximum speed of the block is : **[JEE-Main-2019]**

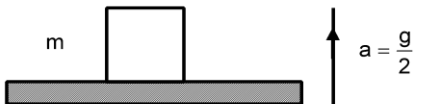


(1) $\frac{F}{\pi\sqrt{mk}}$ (2) $\frac{\pi F}{\sqrt{mk}}$ (3) $\frac{F}{\sqrt{mk}}$ (4) $\frac{2F}{\sqrt{mk}}$

9. A force acts on a 2 kg object so that its position is given as a function of time as $x = 3t^2 + 5$. What is the work done by this force in first 5 seconds ? **[JEE-Main-2019]**

(1) 850 J (2) 900 J (3) 875 J (4) 950 J

10. A block of mass m is kept on a platform which starts from rest with constant acceleration g/2 upward, as shown in figure. Work done by normal reaction on block in time t is : **[JEE-Main-2019]**



(1) $\frac{mg^2t^2}{8}$ (2) 0 (3) $-\frac{mg^2t^2}{8}$ (4) $\frac{3mg^2t^2}{8}$

11. A particle which is experiencing a force, given by $\vec{F} = 3\hat{i} - 12\hat{j}$, undergoes a displacement of $\vec{d} = 4\hat{i}$. If the particle had a kinetic energy of 3J at the beginning of the displcement, what is kinetic energy at the end of the displacement? **[JEE-Main-2019]**

(1) 9 J (2) 15 J (3) 10 J (4) 12 J

Answers

EXERCISE - 1

SECTION (A) :

1.	(3)	**2.**	(3)	**3.**	(1)	**4.**	(3)	**5.**	(2)	**6.**	(3)	**7.**	(1)
8.	(2)	**9.**	(3)	**10.**	(2)	**11.**	(2)	**12.**	(1)	**13.**	(2)	**14.**	(2)
15.	(3)	**16.**	(1)	**17.**	(3)								

SECTION (B) :

1.	(1)	**2.**	(4)	**3.**	(4)	**4.**	(3)	**5.**	(1)	**6.**	(3)	**7.**	(3)
8.	(1)	**9.**	(2)	**10.**	(2)	**11.**	(2)						

SECTION (C) :

1.	(1)	**2.**	(2)	**3.**	(4)	**4.**	(4)	**5.**	(2)	**6.**	(4)	**7.**	(1)
8.	(1)	**9.**	(1)	**10.**	(4)	**11.**	(1)	**12.**	(1)	**13.**	(2)	**14.**	(3)
15.	(3)	**16.**	(4)	**17.**	(1)	**18.**	(4)	**19.**	(4)	**20.**	(4)	**21.**	(3)
22.	(1)	**23.**	(1)	**24.**	(2)	**25.**	(3)	**26.**	(1)	**27.**	(2)	**28.**	(3)
29.	(1)	**30.**	(3)	**31.**	(1)	**32.**	(3)	**33.**	(3)				

SECTION (D) :

1.	(3)	**2.**	(4)	**3.**	(1)	**4.**	(2)	**5.**	(3)	**6.**	(1)	**7.**	(2)
8.	(4)	**9.**	(2)	**10.**	(3)	**11.**	(3)	**12.**	(1)	**13.**	(1)	**14.**	(2)
15.	(2)	**16.**	(3)	**17.**	(1)	**18.**	(2)	**19.**	(1)	**20**	(2)	**21.**	(1)
22.	(2)	**23.**	(1)	**24.**	(4)	**25.**	(1)	**26.**	(3)	**27.**	(2)	**28.**	(2)
29.	(2)	**30.**	(2)										

SECTION (E) :

1.	(3)	**2.**	(2)	**3.**	(4)	**4.**	(3)	**5.**	(1)	**6.**	(4)	**7.**	(1)
8.	(4)	**9.**	(1)	**10.**	(1)	**11.**	(1)	**12.**	(4)	**13.**	(2)	**14.**	(4)
15.	(3)	**16.**	(2)	**17.**	(3)	**18.**	(1)	**19.**	(4)	**20.**	(3)	**21.**	(2)
22.	(2)												

SECTION (F) :

1.	(3)	**2.**	(1)	**3.**	(1)	**4.**	(1)	**5.**	(2)	**6.**	(1)	**7.**	(1)
8.	(2)	**9.**	(3)	**10.**	(2)	**11.**	(4)						

EXERCISE - 2

1.	(2)	**2.**	(4)	**3.**	(1)	**4.**	(2)	**5.**	(2)	**6.**	(1)	**7.**	(1)
8.	(3)	**9.**	(3)	**10.**	(1)	**11.**	(3)	**12.**	(3)	**13.**	(1)	**14.**	(1)
15.	(3)	**16.**	(3)	**17.**	(2)	**18.**	(1)	**19.**	(3)	**20.**	(3)	**21.**	(4)
22.	(3)	**23.**	(2)	**24.**	(3)								

EXERCISE - 3

PART - I

1.	(1)	**2.**	(1)	**3.**	(2)	**4.**	(1)	**5.**	(4)	**6.**	(4)	**7.**	(2)
8.	(2)	**9.**	(4)	**10.**	(2)	**11.**	(4)	**12.**	(4)	**13.**	(4)		
14.	(4)	**15.**	(3)										

PART - II

1.	(3)	**2.**	(3)	**3.**	(3)	**4.**	(2)	**5.**	(2)	**6.**	(4)	**7.**	(1)
8.	(3)	**9.**	(2)	**10.**	(4)	**11.**	(2)						